Claims:

1. A field emitter beam source (10) comprising:

an emitter (11);

an extracting electrode (19) to extract a beam current (I_E) from the emitter (11);

a first voltage source (13) for providing a first voltage (U_A) between the emitter (11) and the extracting electrode (19) to switch on the beam current (I_E);

a current source (12) for providing a predetermined beam current (I_{E0});

the current source (12) being coupled to the first voltage source (13); and

a first switch (S_1) for disconnecting the first voltage source (13) from the current source (12).

2. The field emitter beam source (10) according to claim 1, comprising a second voltage source (15) for providing a second voltage (U_B) between the emitter (11) and the extracting electrode (19) to switch off the beam current (I_E).

3. The field emitter beam source (10) according to claim 1 or 2, comprising a second switch (S_2; S_4) to switch off the beam current (I_E).

4. The field emitter beam source (10) according to any of claims 1 to 3, comprising a fourth switch (S_4) for disconnecting the current source (12) from the emitter (11) and the extracting electrode (19).

5. The field emitter beam source (10) according to any of the preceding claims, comprising a voltage control unit (14) electrically coupled to the first voltage source (13) to adjust the first voltage (U_A) according to a measured emitter voltage (U_{EM}).

6. The field emitter beam source (10) according to claim 5, whereby the voltage control unit (14) is electrically coupled to the current source (12) to measure the measured emitter voltage (U_{EM}).

7. The field emitter beam source (10) according to claim 5 or 6, whereby the voltage control unit (14) comprises a storing unit (14a) to store the measured emitter voltage (U_{EM}); and a third switch (S_3) to determine the time at which the measured emitter voltage (U_{EM}) is stored.

8. The field emitter beam source (10) according to anyone of the claims 5 to 7, whereby the voltage control unit (14) comprises an n-channel MOSFET source follower (16, 18) and the first voltage source (13) comprises a p-channel MOSFET source follower (20, 22), or whereby the voltage control unit (14) comprises a p-channel MOSFET source follower (16, 18) and the first voltage source (13) comprises an n-channel MOSFET source follower (20, 22).

9. The field emitter beam source (10) according to anyone of the preceding claims, further characterized by charge control means (26; S_4) to control the time of switch off of the beam current (I_E) according to a predetermined beam current pulse charge (Q).

10. The field emitter beam source (10) according to claim 9, whereby the charge control means (26; S_4) comprise a fourth switch (S_4) for disconnecting the current source (12) and/or a comparator (26) for comparing the emitter voltage (U_E) with a comparison voltage (U_{CMP}).

11. The field emitter beam source (10) according to claim 10, whereby the comparator (26) is electrically coupled to the second switch (S_2) to connect the second voltage source (15).

12. The field emitter beam source (10) according to anyone of the preceding claims, whereby the field emitter beam source (10) is an array of field emitter beam sources (60).

13. The field emitter beam source (10) according to claim 12, whereby the array of field emitter beam sources is fabricated using CMOS-technology.

14. The field emitter beam source (10) according to anyone of the preceding claims, whereby the predetermined beam current (I_{E0}) is in the range between 1 microampere and 10 picoampere, preferably between 100 nanoampere and 100 picoampere and even more preferred between 20 nanoampere and 1 nanoampere.

15. A field emitter beam source array (60) monolithically integrated onto a substrate (50) comprising an array of field emitter beam sources (10) according to any one of the preceding claims.

16. A field emitter beam source array (60) comprising an array of field emitter beam sources (10) integrated onto a semiconductor substrate (50), whereby:

each field emitter beam source (10) comprises a current source (12) for providing a predetermined beam current (I_{E0});

each field emitter beam source (10) comprises a first switch (S_1) which is electrically coupled to a first voltage source (13) to switch on a beam current (I_E); and

each field emitter beam source (10) comprises a second switch (S_2; S_4) to switch off the beam current (I_E).

17. The field emitter beam source array (60) according to claim 16, whereby the second switch (S_2) is coupled to a second voltage source (15) to switch off the beam current (I_E).

18. The field emitter beam source array (60) according to claim 16 or 17, whereby each current source (12) is coupled to a fourth switch (S_4) to disconnect the current source (12).

19. The field emitter beam source array (60) according to anyone of the claims 16 to 18, whereby each field emitter beam source (10) comprises a voltage control unit (14) to adjust the first voltage (U_A) according to a measured emitter voltage (U_{EM}).

20. The field emitter beam source array (60) according to claim 19, whereby the voltage control unit (14) is coupled to the current source (12) to measure the measured emitter voltage (U_{EM}); and coupled to the first voltage source (13) to adjust the first voltage (U_A).

21. The field emitter beam source array (60) according to anyone of the claims 16 to 20, whereby each field emitter beam source (10) comprises a charge control means (26; S_4) to control a switch off time of the beam current (I_E) according to a predetermined beam current pulse charge (Q).

22. The field emitter beam source array (60) according to claim 21, whereby the charge control means (26; S_4) comprise:

a fourth switch (S_4) for disconnecting the current source (12); and

a comparator (26) for comparing the emitter voltage (U_E) with a comparison voltage (U_{CMP}).

23. The field emitter beam source array (60) according to anyone of the claims 16 to 22, whereby each field emitter beam source (10) comprises an emitter (11) whereby each emitter (11) is electrically coupled to one of said current sources (12), one of said first switches (S_1), one of said second switches (S_2), one of said voltage control units (14), and/or one of said charge control means (26; S_4).

24. The field emitter beam source array (60) according to anyone of the claims 16 to 23, whereby the second voltage source (15) is common to all field emitter beam source (10).

25. The field emitter beam source array (60) according to any of the claims 16 to 24, whereby the number of field emitter beam sources is larger than four, preferably, larger than 1000 and even more preferred larger than 100,000.

26. Electron beam device, comprising at least one of the field emitter beam sources and/or field emitter beam source arrays according to anyone of the preceding claims.

27. A method for generating beam current pulses comprising the steps:

providing a field emitter beam source (10) having at least one emitter (11) and at least one extracting electrode (19);

providing a predetermined beam current (I_{E0}); and

switching on the beam current (I_E) by applying a first voltage (U_A) between the emitter (11) and the extracting electrode (19).

28. The method according to claim 27, whereby an emitter voltage (U_E) between the emitter (11) and the extracting electrode (19) is measured to obtain a measured emitter voltage (U_{EM}).

29. The method according to claim 27 or claim 28, whereby the first voltage (U_A) is adjusted to be equal to the measured emitter voltage (U_{EM}).

30. The method according to anyone of the claims 27 to 29, whereby the beam current (I_E) is switched off by applying a second voltage (U_B) between the emitter and the extracting electrode.

31. The method according to anyone of the claims 27 to 30, whereby the predetermined beam current (I_{E0}) is provided by means of a current source (12).

32. The method according to anyone of the claims 27 to 31, whereby the first voltage (U_A) is provided by a first voltage source (13).

33. The method according to anyone of the claims 30 to 32, whereby the second voltage (U_B) is provided by a second voltage source (15).

34. The method according to anyone of the claims 28 to 33, whereby the measured emitter voltage (U_{EM}) is obtained at a time when the predetermined beam current (I_{E0}) is provided for the emitter.

35. The method according to anyone of the claims 28 to 34, whereby the measured emitter voltage (U_{EM}) is measured periodically within intervals of less than 100 s, preferably less than a second and even more preferred less than a millisecond.

36. The method according to anyone of the claims 29 to 35, whereby the first voltage (U_A) is adjusted periodically within intervals of less than 100 s, preferably less than a second and even more preferred less than a millisecond.

37. The method according to anyone of the claims 29 to 36, whereby between two consecutive adjustments of the first voltage (U_A), the beam current (I_E) is switched on at least two times, preferably at least 100 times and even more preferred at least 10,000 times.

38. The method according to anyone of the claims 29 to 37, whereby the first voltage (U_A) is adjusted by means of a voltage control unit (14) controlling the first voltage source (13).

39. The method according to anyone of the claims 27 to 38, comprising the steps:

disconnecting the current source (12), the first voltage source (13) and the second voltage source (15); and

switching off the beam current (I_E) when the decreasing emitter voltage (U_E) has reached a predetermined comparison voltage (U_{CMP}).

40. The method according to claim 39, whereby the switching off of the beam current (I_E) is initiated by a voltage comparator means (26; S4) comparing the emitter voltage (U_E) with the predetermined comparison voltage (U_{CMP}).

41. The method according to anyone of the claims 27 to 40, whereby the predetermined beam current (I_{E0}) is in the range between 1 microampere and 10 picoampere, preferably between 100 nanoampere and 100 picoampere and even more preferred between 20 nanoampere and 1 nanoampere.

42. The method according to anyone of the claims 27 to 41, whereby, after switch off, the beam current (I_E) is reduced by more than 50 %, preferably by more than 90 % and even more preferred by more than 99 % of the predetermined beam current.

43. The method according to anyone of the claims 27 to 41, whereby the first voltage (U_A) becomes connected or disconnected from the emitter (11) or the extracting electrode (19) by means of a first switch (S_1); the second voltage (U_B) becomes connected or disconnected from the emitter (11) or the extracting electrode (19) by means of a second switch (S_2); and/or the current source (12) becomes connected or disconnected from the emitter (11) or the extracting electrode (19) by means of a fourth switch (S_4).